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CLARIFICATION OF FIVE GENERA OF PHOXOCEPHALIDAE (MARINE AMPHIPODA)[1]

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The following four genera were treated as subjective synonyms of *Paraphoxus* Sars, 1895, by J. L. Barnard (1960): *Pontharpinia* Stebbing, 1897, *Parharpinia* Stebbing, 1899, *Protophoxus* K. H. Barnard, 1930, and *Trichophoxus* K. H. Barnard, 1930. We present new evidence to effect their revival and to suggest that a fifth genus, *Metharpinia* Schellenberg, 1931, is also valid. We have examined the type-species of all genera except *Metharpinia* and have found minute characters, heretofore unreported, that confirm the distinction of the genera. This study is an outgrowth of a larger work, in preparation, concerning 86 species in 23 genera of Australian Phoxocephalidae. All but three of the Australian genera are new and 80 of the 86 species are new. This pool of taxa approximately doubles the number of species and genera in this family and has given us new information on the generic classification of Phoxocephalidae. We believe that the Australian fauna of Phoxocephalidae contains the most primitive living members of the family but also contains an array of highly advanced genera so as to present a full display of systematic modifications in generic characters. The Australian fauna contains one new endemic genus with 38 species, several new genera with 4–8 species and many others with fewer species. The tightly knit generic characterization of the largest genus,

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allied with the demonstrated cohesiveness of characters in the genera comprising 4–8 species, provides a background out of which the generic validity of *Pontharpinia*, *Parharpinia*, *Protophoxus* and *Trichophoxus* can be established. The large genus, *Birubius*, is established with its type-species but the other 37 species are reserved for description in another place (Barnard and Drummond, in prep.).

Materials and Methods

Specimens of the type-species of the 4 genera (2 of these Australian) to be reestablished plus 84 other Australian species in 21 genera and 20 additional species formerly assigned to *Paraphoxus* have been examined. Approximately 250 characters have been analyzed in each species. Many of these are characters not heretofore considered as important for recording in Phoxocephalidae and might be termed "minute" or "trivial" characters, for example, the presence, number, size and groupings of spines on the medial surfaces of appendages. Among many other "trivial" characters, the fine structure of right lacinia mobili and of cuticular setules has also been examined. Many of the characters actually are class-characters, those in which numerous alternatives of condition have evolved. Many new kinds of attributes have been discovered, mainly those occuring in Australian species but rarely elsewhere as far as we can determine from the phoxocephalid literature. For example, several genera, including *Trichophoxus*, to be revived, bear a spike on uropod 1, composed of a large interramal spine on a ventral protrusion of the peduncle. Characters such as "non-skid" cuticle, heretofore found only in genera of nonphoxocephalid families are found to occur in Australian species. A list of these characters will be presented by Barnard and Drummond (in prep.).

The 86 Australian species were arranged in species clusters according to subjective appraisal of their common characters and the clusters then ordered in numerous trials based on models concerning evolutionary flow in morphocharacters. The main precept of each model was a manifold series of decisions as to the primitive or advanced state of each of the characters, these being juxtaposed and evaluated simulta-

neously in each model. The principle of parsimony was applied to the system and the tenet of irreversibility was adopted, so that once an attribute was lost entirely it could not be regained in a later step. The large genus, *Birubius*, originally comprising 40 species assembled by subjective taxonomic means, was found to have 9 clusters of species. One of these clusters, of 2 species, was found to have qualitative characters separating it from the other 8 clusters. The characters were seen to have apparent generic significance when compared with characters in other taxa. Those other genera had been separated by ordinary taxonomic evaluations and not by clustering methods. The distinctions, comprising fully qualitative characters, found in the separation of 2 species from 38 others, suggested the need to search for similar kinds of distinctions in an overall generic analysis of 86 species. The 8 clusters remaining in the large genus were found to be differentiated only by quantitative characters. We define "qualitative" as meaning present or absent; we define "quantitative" either as being slightly different in shape, proportion, degree and count, or subject to evidence of intergradation from one extreme to another, such as an accessory nail being represented in another species by a vestigial setule. These manipulations were extended to the remaining Australian phoxocephalids so as to result in 86 species being divided among 23 genera. The nomenclature of the genera was then rectified by examining the type-species of named genera and fitting those species to the generic pool. In this process we determined that the 4 genera to be reestablished in this paper are highly distinctive and not synonymous with *Paraphoxus*.

Pereopods are counted as gnathopods 1–2 and pereopods 3–7. The term "mark" (M.) refers to a stated distance from a basal point on a 0 to 100 scale. The term "ordinary" is used in the descriptions to avoid lengthy explanation for characteristics of common occurrence in phoxocephalids. An ordinary rostrum is elongate and unconstricted from dorsal aspect. Ordinary setation on maxilla 2 is a contrast apposed to "weak" setation and is a subjective value judgment. Ordinary inner plates of the maxilliped are broad, elongate, and unfused medially. Ordinary pereopod 7 refers to the great size

of this appendage and its lack of facial setae. The contrast to ordinary refers to the highly miniaturized pereopod 5 of *Trichophoxus* (see illustrations). The term "mitelloid" refers to the shape of the hands on gnathopods 1–2 in *Trichophoxus* which resemble goose-neck barnacles. An epimeron 3 of "rounded-classification" bears a convex posterior margin, no posteroventral tooth and, in addition, has fewer than 3 long setae anywhere on the epimeron. Occasional examples of this kind of epimeron may have 3 extremely small setules posteroventrally. The "special spine" on the peduncle of uropod 1 refers to its displacement on the apex in a ventral direction away from the dorsal margin of the peduncle. Broad and narrow forms of article 2 on pereopod 5 refer to vastly distinctive alternatives in width of that article. Facial counts of spines on article 4 of antenna 1 commence at the distal end. Spine and seta counts on article 1 of the outer ramus on uropod 3 commence proximally; the lateral margin bears acclivities each with one or more spines and setae, thus the formula, acclivities = 8, spines = 0×5, 1×4, setae = 1×5, 2×2 and 2×3 translates to "spine absent on first 5 acclivities, one seta present on each of next 3 acclivities plus apex of article (counted as ninth armament position), one seta on each of first 5 acclivities, 2 each on next 2 acclivities, 3 each on next acclivity plus apex."

History of the *Paraphoxus* Problem

Paraphoxus Sars, 1895, based on *P. oculatus* (Sars), was established to separate that species from the familial type-genus, *Phoxocephalus* Stebbing, on the equality of gnathopods and the nontriturative molar. *Paraphoxus oculatus* is primarily a northern coolwater species widely distributed in the Atlantic and Pacific Oceans. In the description of the genus Sars erred in stating that the first maxillary palp is uniarticulate; instead, it is biarticulate. This unfortunate error in an otherwise superlative description commenced a series of misteps culminating in the gradual amalgamation of several phoxocephalid genera described in later years. The final result was the synonymy promulgated by J. L. Barnard (1960) in which *Pontharpinia*, *Parharpinia*, *Protophoxus* and *Tricho-*

phoxus were treated as subjective junior synonyms of *Paraphoxus*. Many good taxonomic characters had been overlooked by that time, those characters having been considered to be valuable only at specific level.

Stebbing (1897) established *Pontharpinia* for *Urothoe pinguis* Haswell, 1879b. Stebbing did not mention *Paraphoxus* in his comparisons, and unfortunately his diagnosis is erroneous because he did not have in hand *Urothoe pinguis* Haswell but another species of phoxocephalid now known as *Paraphoxus stebbingi* J. L. Barnard, 1958. We have learned that *pinguis* and *stebbingi* are not congeneric, indeed they are vastly different and probably should be relegated to distinct subfamilies (to be considered elsewhere) within the Phoxocephalidae. Although *Pontharpinia* is a confounded genus we believe that it should be retained, with *Urothoe pinguis* as type-species; a new diagnosis of the genus is presented below. *Paraphoxus stebbingi* belongs to a new genus with affinities to *Trichophoxus*. That genus will be described elsewhere but Stebbing's species will not be designated as the type-species. Although we recognize the genus to which *P. stebbingi* belongs, we have been unable to locate Stebbing's specimen either in the British Museum of Natural History, the Universitets Zoologiske Museum in Copenhagen or The Australian Museum.

In the Australian study we have not been able to identify *stebbingi* among the 5 species in the genus. The specimen Stebbing had in hand was one set to him by Haswell long after the establishment of *U. pinguis* and from a different site than the type-locality. Stebbing's *Pontharpinia* was included in a paper otherwise concentrated on collections of the Copenhagen Museum but apparently the specimen was not given to the Copenhagen Museum nor returned to Haswell and deposited in the Australian Museum, nor was it given to Stebbing's national museum, the British Museum of Natural History. To trace the exact species Stebbing had in hand may require investigation of the kinds of amphipods in Jervis Bay, New South Wales, the original site of Stebbing's specimen.

The 5 species of the new genus, to be described, that will contain *Paraphoxus stebbingi*, are characterized interspecifically by spination patterns on uropods 1–2 and the pres-

ence, absence, or degree of development of combs on those uropods. The crucial description of these parts was not given by Stebbing.

Pontharpinia is highly distinct from *Paraphoxus*. J. L. Barnard (1960) made a partial evaluation of the type-species *pinguis* based on notes made by K. Sheard and concluded that the genus was synonymous with *Paraphoxus*. Unfortunately the mandible of the so-called type-specimen was missing; that mandibular molar is triturative, thus demonstrating a strong distinction. We have now identified numerous specimens of *pinguis* by comparison with that so-called type-specimen and with Haswell's description and find numerous distinctions from *Paraphoxus* as outlined in the generic diagnosis to follow.

Stebbing (1899) established *Parharpinia* in a short paragraph, with *Phoxus villosus* Haswell, 1879a, as type-species. Again, this is a confounded genus because Stebbing had in hand a specimen from New Zealand loaned to him by G. M. Thomson and identified as *Phoxus batei*. Stebbing was under the impression that this entity was synonymous with *Phoxus villosus* from Australia. Hurley (1954) demonstrated that the specimen identified by Thomson as *P. batei* is in fact *Pontharpinia australis* (K. H. Barnard), originally described as the type-species of *Protophoxus* and now to be returned to that appellation. *Phoxus batei* Haswell 1879a, itself is a good species to be relegated to *Birubius*, new genus. Stebbing (1906) relegated *P. batei* to *P. rostratus* (Dana, 1853), but that synonymy cannot be supported. Parenthetically, the so-called original material of *Phoxus batei* is confounded; the specimens labeled *Phoxus batei* residing in the Australian Museum are clearly not what Haswell described; we can identify what Haswell described with fair precision. J. L. Barnard (1974) discussed this recurrent problem that most, if not all, of Haswell's amphipod types were labeled "Type" or perhaps reidentified at a much later date, between 24 and 74 years after the fact, some apparently in the early 1900's by unknown hands but some as late as the 1950's by the late Dr. Sheard. In most cases the later selection was correct, but, the specimens selected for *P. batei* belong to *Birubius*. We believe that in most

cases Haswell did not participate in the selection of specimens labeled "Type" and that therefore they would qualify, at best, as lectotypes, once codified by publication as such. We intend to ignore publishing the specimen of *P. batei* now called "Type" so as to conserve Haswell's name for an easily recognized species.

We now know that *Parharpinia* differs from *Paraphoxus* in numerous characters as seen in the diagnoses to follow but more importantly, *Parharpinia*, with 2 species in Australia, forms a genus with intergradations between *Birubius*, the basic *Australian* genus (containing 38 species), and the two groups of genera to which *Trichophoxus* and *Protophoxus* belong. *Birubius* carries only apicoposterior telsonic spines, whereas *Parharpinia* carries dorsal telsonic spines or setae and furthermore bears a special spine on uropod 1. *Parharpinia* also appears to be near the ancestral pool for several other new Australian genera by virtue of posterior setation on epimera 1–2.

Protophoxus K. H. Barnard, 1930, for *P. australis* K. H. Barnard, 1930, was described sketchily to distinguish a species thought by Barnard to bear relationship to *Phoxocephalus* and therefore was distinguished from that genus but not from *Paraphoxus* nor *Pontharpinia*. The latter genus had by that time become the repository for the bulk of paraphoxinlike species because those species fitted the diagnosis of *Pontharpinia* best in light of its known biarticulate palp of the first maxilla and the broad pereopods 5–6; other species had, however, been placed in *Parharpinia* to fit the concept of thin pereopods 5–6. K. H. Barnard's diagnosis of *Protophoxus* contained only 2 characters. the biarticulate palp of maxilla 1 and the elongate wrists of the gnathopods. Five figures, i.e., gnathopods 1 and 2, epimeron 3, telson and a sketch of antenna 2 plus a medium-sized description established the type-species. We now recognize that the presence of dorsal spines on the telson is the best clue to suggest that *Protophoxus* bears no relationship to *Paraphoxus*. Hurley (1954) redescribed *"Pontharpinia" australis* from a specimen collected a few hundred miles from the type-locality and which differed, as far as Hurley could distinguish from the meager first description, only in the reduced number of dorsal telsonic spines. We have

now reexamined some of the syntypes of *P. australis* and find Hurley's excellent portrayal of the species to be exact and the distinction he noted to be minor but perhaps indicative of infraspeciation, perhaps a reflecton of clinal phenotypy. *Protophoxus* bears a close resemblance to *Parharpinia*, especially in the presence of dorsal spination or setation on the telson. But several good generic distinctions separate the 2 taxa as stated in the diagnoses to follow. Each genus has a special spine on uropod 1 but on opposite sides from each other.

Trichophoxus was established by K. H. Barnard, 1930, for *T. capillatus* K. H. Barnard, 1930, again in comparison to *Phoxocephalus* and with a short diagnosis confined to "mandible with molar conical, lacking the triturating surface, and tipped with 4 strong spines; and 5th joint of both gnathopods elongate." Illustrations of head, gnathopod 1, antenna 1, telson, epimeron 3 and pereopod 7 accompanied a medium-sized description. We now know that various characters on pereopod 7, gnathopod 1 and the telson have generic value. The written description of the mandibular molar weakly fits the general situation in *Paraphoxus* and in the supposed but confounded descriptions cited for *Parharpinia* and *Pontharpinia*. We have examined and established a lectotype for *T. capillatus* and have determined that this molar is actually distinct in high degree from the molar attributed to various species formerly placed in *Paraphoxus*, *Pontharpinia* and *Parharpinia*. The molar is large, subconical, but truncate, has a definite semiarticulate base and bears 4 very large spines only partly articulate and consistently fixed in a pattern of size and shape (see illustrations). We confirm the consistency of this molar in 5 species of a related new genus from Australia and in *Paraphoxus rakiura* Cooper and Fincham, 1974, a species from New Zealand which should be transferred to a new and distinctive genus based on patterns of uropodal spination and setation.

Metharpinia Schellenberg, 1931, was described for 2 species, *M. longirostris* Schellenberg, 1931, and *M. cornuta* Schellenberg, 1931, neither of which, as yet, has been designated as type-species of the genus. Although J. L. Barnard (1960) reexamined these species, few new observations were pub-

lished. The lateral setation of the telson suggests generic differentiation from those genera diagnosed herein but numerous other minute details must be determined before a type-species is selected and the genus revived.

During the years between 1906 and 1957 three species of phoxocephalid were described in *Paraphoxus*, 9 in *Pontharpinia* (with 3 additional synonyms) and 7 species in *Parharpinia.* Apparently these species were assigned to genera mainly on the basis of Stebbing's (1906) key to the genera of *Phoxocephalidae*, in which *Paraphoxus* was erroneously attributed a uniarticulate palp on maxilla 1, *Pontharpinia* was erroneously attributed a nontriturative mandibular molar and *Pontharpinia* and *Parharpinia* were distinguished on the stoutness of pereopods 5–6. Apparently the species assigned to *Paraphoxus* were placed there mainly on the overall facies rather than on the condition of maxilla 1.

J. L. Barnard (1960) in assembling a pool of 40 species, synonymized all of these genera on the thesis that stoutness of pereopods 5–6 was variable in the pool of species being treated, that all were known or suspected to have a biarticulate palp on maxilla 1, that the elongation of article 5 on gnathopods was variable and that widths of rostra were variable. All were presumed to have a simple mandibular molar bearing a few semiarticulate, tightly clumped spines, a fact we now know to be erroneous in *Trichophoxus* and *Pontharpinia*; and we now know that the kind of spine clumping on the molar of *Paraphoxus* is a good generic character.

Our study of Australian phoxocephalids demonstrates a secondary importance of rostral dimensions as a generic character and an imperfect association between pereopodal widths and generic or subfamilial categorizations, but many of the following characters should be brought into the pool of important characters: fine structure of molars, proportions of and setal distribution on article 2 of antenna 1 and on article 5 of antenna 2, facial spine and setal distributions on articles 3–4 of antenna 2, shapes and dominance of epistome and upper lip but not necessarily the degree of cuspidation, size of palpar hump on mandible, presence or absence of cones on the lower lip, setation counts on the inner plate of maxilla 1,

degree of cleft between inner lobes of the maxillipeds, linear or nonlinear arrangement of facial setae on article 3 of the maxillipedal palp, length and shape of the dactyl on the maxilipeds and the condition of the apical nail and attendant accessory setae, shapes and setosity of gnathopods in terms of shortened and cryptic article 5, anterior setal density on hands, degree of palmar slope, enlargement of gnathopod 2 and eusirid-like attachments of articles, presence or absence of posteroproximal setae on article 5 of pereopods 3–4, presence and size of midapical subdactylar spine on article 6 of pereopods 3–4, apical ornamentation of dactyls on pereopods 3–4, size and shape of pereopod 7 articles 2–3, presence or absence of dactyl on pereopod 7, presence or absence of combs in various places on pereopods and uropods including medial surfaces and rami, presence or absence of long flexible setae in various places on epimera and uropods, numbers and shape of apical setae on article 2 of outer ramus on uropod 3, presence or absence or degree of development of thick spines on uropods and urosomal surfaces, lengths of rami of uropods 1–2 with special attention to inner ramus of uropod 2, degree of fusion of inner ramus of uropod 2 to peduncle, size and presence of glandular tissue in urosome, fusion, setation and presence of spines on urosomites, presence and number of apical, dorsal and lateral spines on telson, and, finally, gill formulas.

Paraphoxus Sars

Paraphoxus Sars, 1895: 148–149.

Diagnosis of male and female: Eyes present; flagella of antennae 1–2 unreduced, article 1 of antenna 1 bearing medial fuzz in male, article 2 short, setae confined distally, primary flagellum with calceoli in male; antenna 2 lacking ensiform process, article 3 with only 2 facial setules, apicalmost elongate, article 5 somewhat shortened, bearing dorsal calceoli in male, flagellum with calceoli in male; upper lip and epistome distinct, epistome dominant; right mandibular incisor with 3 teeth, molar not triturative, small, forming weakly conical boss, bearing clump of 3 articulate spines on basal plate, no fuzz, right lacinia mobilis bifid, rami subequal in length, lacking facial denticles, palper hump of mandible small; lower lip bearing cones; palp of maxilla 1 biarticulate, inner plate with 2 setae; inner plates of maxilliped ordinary, poorly setose, palp article 3 scarcely protuberant, dactyl elongate, apical nail elongate, not

immersed; gnathopods small but hands weakly enlarged, almost identical in shape, article 5 shortened, hands ovatorectangular, poorly setose anteriorly, palms oblique; article 5 of pereopods 3–4 bearing setae posteroproximally but not fully to base, article 6 bearing normal 2 rows of spines, middistal armament absent, dactyls lacking inner tooth, bearing subapical slit, apical nail distinct but partly immersed; article 2 of pereopod 5 of broad form, untapering, of pereopod 7 of ordinary phoxocephalid kind, article 3 of pereopod 7 small (ordinary), articles 4–5 of pereopods 5–6 narrow, pereopod 7 of normal size, article 2 ventrally naked (lacking long setae); peduncular apices of uropods 1–2 minutely combed, peduncle of uropod 1 normally elongate, lacking ventral spike or special spines, medial spines widely spread, dorsal spines confined apically (not shown in Sars, 1895), inner ramus of uropod 1 bearing only 1 row of spines, peduncle of uropod 2 with 1 short medial spine set apically plus 1 midmedial seta, inner ramus spinose, as long as outer ramus, uropod 3 especially elongate, article 2 of outer ramus with only 2 apical setae; telson naked laterally and dorsally except for normal pair of setules set about mark 50 (not shown in Sars, 1895); urosomite 1 devoid of major lateral spines and ventral setae; epimera 1–2 lacking posterior setae, with facial setae located ventrally (not shown in Sars, 1895), none in midface, epimeron 3 lacking posterior setae, of special "rounded-classification" form, lacking midfacial setae or spines.

Description: Rostrum large and broad; facial spines on article 4 of antenna 2 primarily in one row, but second row of one spine and setule present, article 5 thin; article 1 of mandibular palp weakly elongate, apex of article 3 truncate but scarcely oblique, palp thin, distal branch of right lacinia mobilis broad, serrate minutely, proximal branch like raker spine; outer plate of maxilla 1 with 11 spines plus inner articulate apical plumose seta (not shown in Sars, 1895), one spine especially thickened; setation of maxilla 2 ordinary; inner and outer plates of maxilliped ordinary but inner plate poorly setose, lacking thick apical spine(s) [this character not confirmed]; coxae 2–4 lacking anterodorsal humps; article 5 of gnathopod 2 free (not cryptic); article 2 of pereopod 7 with small posterior teeth, lacking facial setae; gills present on pereonites 2–7.

Type-species: *Phoxus oculatus* Sars, 1879 (monotypy).

Composition: The type-species and possibly *Parharpinia simplex* Gurjanova, 1938. All other species ever assigned to *Paraphoxus* are to be removed to other genera, mostly new. See "Allocation in *Paraphoxus*" to follow.

Relationship: Our study of Australian phoxocephalids has revealed a group of 5 new genera containing 9 species in which *Paraphoxus* fits as a highly specialized and advanced taxon from cool waters of the northern hemisphere. This group of genera is distinguished by the following combination of characters: (1) the sole presence on the mandibular molar of a group of 3 tightly packed and partly fused (basal) spines (inadequately shown in Sars, 1895); (2) article 2 of antenna 1

short; (3) all thick facial spines on article 4 of antenna 2 peduncle aligned in a single row; (4) setae on inner plate of maxilla 1 reduced in number from the usual 4 found in primitive Australian genera; (5) article 2 of pereopods 6–7 with only one main facial ridge; (6) inner plate of maxilliped lacking stout apical spines; (7) epimeron 3 of "rounded-classification", lacking any elongate setae, protruding posteriorly, and, at most, bearing 3 setule notches. The following characters are often useful in recognizing members of this generic group but the characters are not universally present: (1) apical combs on the peduncles of uropods 1–2; (2) articles 4–5 of pereopods 5–6 very thin (with one weak exception); (3) article 5 of antenna 2 shortened in females, this observation based on primitive phoxocephalids bearing a more elongate article 5; (4) article 6 of pereopods 3–4 with some component spines elongate and thin, almost classifiable as flexible setae (with 2 generic exceptions). These genera also share numerous other similarities most of which in the broader context are useful in genera outside this system at specific level. One example is the absence of accessory apical nails on the rami of uropods 1–2; in certain new Australian genera the presence or absence of these accessory nails is useful taxonomically only at specific level; another example is the presence of a special cusp or articulate setule medially on the outer plate of maxilla 1.

The Australian genera of this complex can be arranged in an evolutionary sequence to demonstrate that in the primitive state taxa are characterized by an enlarged gnathopod 2 with cryptic article 5, whereas in the advanced or specialized state gnathopod 2 is reduced to a size similar to gnathopod 1, with the posterior margin of article 5 free from envelopment. *Paraphoxus* represents the advanced state of this condition.

The characters of the generic diagnosis have been confirmed from material of *Paraphoxus oculatus* (Sars) deposited in the U.S. National Museum of Natural History and identified by comparison to pl. 51 of Sars, 1895.

Allocation of Species in *Paraphoxus*

Those species formerly assigned to *Paraphoxus* not now confined to the genera herein restricted must be removed from *Paraphoxus* and allocated to newly created genera. This process is difficult because many of the species are poorly described and cannot be so allocated until they have been reexamined minutely. We detect a pattern of classification in the species adequately described as outlined below. New genera for these taxa will be described elsewhere.

I. Peduncle of uropod 1 with special medial spine.
   A. Pereopods 5–6 with stout articles 4–5; wrists of gnathopod 2 slightly elongate.
      Pontharpinia epistoma Shoemaker, 1938: 326; J. L. Barnard, 1960: 205 (as *Paraphoxus*); Bousfield, 1973: 126 (as *Trichophoxus*)

Pontharpinia floridana Shoemaker, 1933: 5; J. L. Barnard, 1960: 226 (as *Paraphoxus*)
Paraphoxus gemmatus J. L. Barnard, 1969: 222
Paraphoxus jonesi J. L. Barnard, 1963: 463
Paraphoxus lucubrans J. L. Barnard, 1960: 212

B. Pereopods 5–6 with thin articles 4–5.
1. Wrist of gnathopod 2 shortened; setae on article 2 of antenna 1 widely spread.
Paraphoxus cognatus J. L. Barnard, 1960: 233
?*Parharpinia fuegiensis* Schellenberg, 1931: 78; J. L. Barnard, 1960: 271 (as *Paraphoxus*); pereopod 3 not thin (to a new genus to be described)
Paraphoxus similis J. L. Barnard, 1960: 230
Paraphoxus spinosus Holmes, 1905: 477; J. L. Barnard, 1960: 243
2. Wrist of gnathopod 2 not shortened; setae on article 2 of antenna 1 set apically (and telson with lateral setae). *Parharpinia sinuata* K. H. Barnard, 1932: 103

II. Peduncle of uropod 1 lacking special spine.
A. Articles 4–5 of pereopods 5–6 stout, facial spines on article 4 of antenna 2 in 2 or more rows.
1. Epimera 1–2 with posterior setae, telson with supernumerary dorsal setation.
Pontharpinia milleri Thorsteinson, 1941: 82; J. L. Barnard, 1960: 266 (as *Paraphoxus*); *Pontharpinia robusta* Gurjanova, 1938: 262
Pontharpinia obtusidens Alderman, 1936: 54; J. L. Barnard, 1960: 249 (as *Paraphoxus*); *Pararpinia* [sic] *pontarpioides* Gurjanova, 1953: 229
2. Epimera 1–2 lacking long posterior setae, telson lacking supernumerary dorsal setation.
a. Gnathopods with mitelloid hands, thin and/or highly setose anteriorly.
Paraphoxus abronius J. L. Barnard, 1960: 203
Paraphoxus bicuspidatus J. L. Barnard, 1960: 218
Paraphoxus fatigans J. L. Barnard, 1960: 209
Pontharpinia tridentata J. L. Barnard, 1954: 4; 1960: 261 (as *Paraphoxus*)
Paraphoxus variatus J. L. Barnard, 1960: 198
Paraphoxus vigitegus J. L. Barnard 1971: 70 (but urosome with spike)
b. Gnathopods ordinary, hands ovatorectangular, poorly setose anteriorly.
Paraphoxus daboius J. L. Barnard, 1960: 210
Paraphoxus heterocuspidatus J. L. Barnard, 1960: 224
Pontharpinia rostrata Dana of Pirlot, 1932: 62
Paraphoxus stenodes J. L. Barnard, 1960: 211

B. Articles 4–5 of pereopods 5–6 thin, facial spines on article 4 of antenna 2 mostly confined to one row.
   1. Wrists of gnathopods elongate, ventral setae on article 2 of antenna 1 widely spread.
      Parharpinia calcarata Gurjanova, 1938: 272; J. L. Barnard, 1960: 238 (as *Paraphoxus*)
      Paraphoxus robustus Holmes, 1908: 618; J. L. Barnard, 1960: 235
      Paraphoxus subuncigerus Kudrjaschov, 1965: 1776
   2. Wrists of gnathopods short, ventral setae on article 2 of antenna 1 confined apically.
      Pontharpinia uncinata Chevreux, 1912: 100

List of Species Rejected from *Paraphoxus*

Protophoxus australis K. H. Barnard, 1930: 335 (to *Protophoxus*)
Phoxus batei Haswell, 1879: 259 (to *Birubius*)
Trichophoxus capillatus K. H. Barnard, 1930: 336 (to *Trichophoxus*)
Metaharpinia cornuta Schellenberg, 1931: 68 (to *Metharpinia*)
Metharpinia longirostris Schellenberg, 1931: 65 (to *Metharpinia*)
Urothoe pinguis Haswell, 1879a: 325 (to *Pontharpinia*)
Paraphoxus rakiura Cooper and Fincham, 1974 (should be established in a new genus)
Paraphoxus stebbingi J. L. Barnard, 1958: 148 (to a new genus to be described)
Paraphoxus tattersalli J. L. Barnard, 1958: 148; 1960: 282 (to a new genus to be described)
Phoxus villosus Haswell, 1879: 258 (to *Parharpinia*)
Paraphoxus waipiro J. L. Barnard, 1972: 143 (to a new genus to be described)
Paraphoxus sp. Australia, J. L. Barnard, 1960: 285 (to a new genus to be described)

List of Unclear Species of "*Paraphoxus*"

Pontharpinia barnardi Pirlot, 1932: 62; for *P. rostrata* of K. H. Barnard, 1931:119 [not Dana, 1853]; pereopod 5 and epimeron 3 unusual
Pontharpinia centralis Schellenberg, 1938: 15; pereopods 5–6 thin
Pontharpinia maxima Stephensen, 1947: 42; possibly close to *P. pyripes*; uropod 1 with ventral peduncular setae
Pontarpinia [sic] *nasuta* Gurjanova, 1936: 249; 1951: 382
Parharpinia obliqua K. H. Barnard, 1932: 101; probably similar to new genus of paraphoxin from Australia to include *P. tattersalli*, new genus, to be established by Barnard and Drummond (in prep.)
Pararpinia [sic] *ochotica* Gurjanova, 1953: 225
Paraphoxus pyripes K. H. Barnard, 1930: 332; perhaps similar to *P. maxima* but gnathopod 2 probably enlarged

Parharpinia rotundifrons K. H. Barnard, 1932: 104; ?Stephensen, 1947: 44; gnathopods probably like basic Australian genus as cited above under *P. obliqua*

Parharpinia uncigera Gurjanova, 1938: 267; 1951: 388; pereopods 5–6 thin, article 4 of antenna 2 stunted, possibly article 6 of pereopods 3–4 lacking posterior spines.

Pontharpinia Stebbing

Pontharpinia Stebbing, 1897: 32–33.

Diagnosis of female [adult male unkown]: Eyes present; flagella of antennae 1–2 unreduced, fuzz on article 1 of antenna 1 unknown in male, article 2 of antenna 1 short, setae widely spread on ventral surface, calceoli on primary flagellum of male antennae unknown; antenna 2 with weak ensiform process, article 3 with groups of 5 + 1 facial setae; article 5 shortened; upper lip and epistome not strongly distinct from each other; right mandibular incisor with 3 teeth, molar fully triturative, small, cylindrical, right lacinia mobilis bifid, rami equal, bearing weak facial denticles, palpar hump of mandible of medium size; lower lip of mandible lacking cones; palp of maxilla 1 biarticulate, inner plate with 5 or more setae; inner plates of maxilliped ordinary, palp article 3 weakly protuberant, dactyl elongate, apical nail small, mostly immersed; gnathopod 1 small, gnathopod 2 enlarged, of diverse shapes, article 5 of gnathopod 2 greatly shortened, hands expanded, rectangular, poorly setose anteriorly, palms oblique; article 5 of pereopods 3–4 lacking posteroproximal setae, article 6 bearing normal 2 rows of spines, mid-distal armament composed of medium to small spine, dactyls bearing 1 inner tooth; article 2 of pereopod 5 of broad form and expanding distally, of pereopod 7 of ordinary phoxocephalid kind, article 3 of pereopod 7 small (ordinary), articles 4–5 of pereopods 5–6 broad, pereopod 7 of normal large size, article 2 ventrally setose; peduncular apices of uropods 1–2 not combed, peduncle of uropod 1 normally elongate, lacking ventral spike but bearing special large apico*medial* spine, other medial armaments widely spread, dorsal spines widely spread, inner ramus of uropod 1 bearing only one row of spines, peduncle of uropod 2 with medial spines widely spread, inner ramus spinose, as long as outer ramus, uropod 3 ordinary, article 2 of outer ramus with 3 apical setae and subapical lateral spine-seta; telson with only apical spines but each lobe with huge crescentic brush of setae midlaterally, other setules abnormal, one each confined dorsobasally on each lobe; urosomite 1 with ventral crescentic brush of setae; epimera 1–2 naked posteriorly, with all facial setae ventrally placed, epimeron 3 with midfacial setae.

Description: Rostrum large and ordinary; facial spines on article 4 of antenna 2 in 2 or more rows; article 5 thin; article 1 of mandibular palp short, palp of medium thickness but huge in comparison to mandibular body; outer plate of maxilla 1 with 11 spines, one spine especially thickened; setation of maxilla 2 ordinary; coxae 2–4 lacking antero-

dorsal humps; article 5 of gnathopod 2 cryptic (posterior margin concealed by articles 4 and 6); article 2 of pereopod 7 with small posterior teeth, bearing numerous groups of facial setae; gills present on pereonites 2–7.

Type-species: *Urothoe pinguis* Haswell, 1879a (monotypy).

Relationship: The genus and its unique species may be the most primitive living phoxocephalid in the present context of this family (assuming full rostral development as a prerequisite or barring other discoveries). Like *Phoxocephalus* and *Leptophoxoides* it bears a fully triturative mandibular molar, a character assumed to be primitive, short article 2 of antenna 1, and an enlarged gnathopod 2, but unlike the more advanced *Phoxocephalus* and *Leptophoxoides* it has a higher number of setae on the inner plate of maxilla 1, continuously spinose rami on uropods 1–2 and facial setae on article 2 of pereopod 7, all characters which might be marks of relationship to gammaroid-haustorioid ancestors. Nevertheless *Pontharpinia* obviously is a very advanced taxon of amphipod in that it has specializations that must remove it from the direct ancestral pool of other phoxocephalids. Its primitiveness is simply a hypothetical assessment; it has never lost certain marks of its ancestors which we consider are weak character linkages to an ancestral stream of species.

Pontharpinia pinguis retains many of the characters lost in various degrees in other genera of phoxocephalids, such as: special spine on peduncle of uropod 1, enlarged gnathopod 2, short and cryptic article 5 of gnathopod 2, dispersed facial setae on article 3 of palp on maxilliped, full rostrum, facial setae on pereopod 7, triturative molar, ensiform antenna 2, fully setose maxilla 2, widely setose inner plate of maxilla 1, inner tooth on dactyls of pereopods, broad articles on pereopods 5–6, posterior setae on article 2 of pereopods 5–6, posterior setae on coxa 4, anterior setae on coxa 1, setal brushes on telson, fully flabellate right lacinia mobilis, setose dactyl of pereopod 7, ventrally spread setae on article 2 of antenna 1, continuously spinose rami of uropods 1–2, widely spread ventral setation on epimera 1–2, mainfold setae on article 2 of outer ramus on uropod 3, facial setae on epimeron 3, ventral setae on urosomite 1, subapical setae on peduncle of uropod 3, and lateral setosity on palp article 2 of mandible.

Pontharpinia pinguis, however, has the following characters about which we are unable to confirm the degree of primitiveness; absence of basofacial setae on uropod 1, absence of double spine rows on the inner ramus of uropod 1, absence of lateral spination on the urosome, *short and immersed apical nail on palp article 4 of the maxilliped, unequal flagella on antenna 1, absence of thick apical spines on the inner plates of the maxillipeds, presence of only one (not 2) dorsolateral setule on each lobe of the telson, absence of anterodorsal humps on coxae 1–4, absence of facial setae on coxae 6–7, absence of posteroproximal setae on article 5 of pereopods 3–4, *absence of cones on the lower lip, almost fully amalgamated upper lip and epistome and multiple sets of spines

on article 4 of antenna 2. Except for the two characters marked by asterisks we believe all others are advancements in phoxocephalid evolution.

Parharpinia Stebbing

Parharpinia Stebbing, 1899: 207; 1906: 147.

Diagnosis of male and female: Eyes present; flagella of antennae 1–2 unreduced, article 1 of antenna 1 bearing medial fuzz in male, article 2 short, setae widely spread on ventral surface, primary flagellum lacking calceoli in male (as far as known); antenna 2 lacking ensiform process, article 3 with only 2 facial setules, article 5 not shortened, lacking calceoli in male (as far as known), flagellum also lacking calceoli; upper lip and epistome not strongly distinct from each other; right mandibular incisor with 3 teeth, molar not triturative, small, forming pillow-shaped boss, bearing small articulate spines, fuzz weak to absent, right lacinia mobilis bifid, rami unequal, bearing facial denticles, palpar hump of mandible of medium size; lower lip bearing cones; palp of maxilla 1 biarticulate, inner plate with 4 setae; inner plates of maxilliped ordinary, palp article 3 weakly protuberant, dactyl elongate, apical nail of medium size, mostly immersed; gnathopods small, almost identical in shape but article 5 of gnathopod 2 slightly shortened, hands ovate-rectangular, poorly setose anteriorly, palms oblique; article 5 of pereopods 3–4 bearing posteroproximal setae, article 6 bearing normal 2 rows of spines, middistal armament composed of small to medium spine or thick short seta, dactyls bearing one inner tooth; article 2 of pereopod 5 of broad form but tapering distally, of pereopod 7 of ordinary phoxocephalid kind, article 3 of pereopod 7 small (ordinary), article 4–5 of pereopods 5–6 narrow, pereopod 7 of normal large size, article 2 ventrally setose; peduncular apices of uropods 1–2 not combed, peduncle of uropod 1 normally elongate, lacking ventral spike but bearing special large apico-*medial* spine, other medial spines widely spread, dorsal spines mainly apical, inner ramus of uropod 1 bearing only 1 row of spines, peduncle of uropod 2 with only 1 medial spine (spinule) set apically, inner ramus naked, as long as outer ramus, uropod 3 ordinary, article 2 of outer ramus with 2–4 setae (variable infraspecifically); telson variable in spination, with either or both lateral and dorsal spines, midlateral setules normal, placed at about mark 33, comprising a pair on each side; urosomite 1 devoid of major lateral spines and ventral setae except for distal setae at base of uropod 1; epimera 1–3 with posterior setae, epimera 1–2 with facial setae all ventral, epimeron 3 with few midfacial setae or spines.

Description: Rostrum large and ordinary; facial spines on article 4 of antenna 2 primarily in one row scarcely divided into sections, article 5 thick; article 1 of mandibular palp short, palp thin; outer plate of maxilla 1 with 11 spines, one spine especially thickened; setation of maxilla 2 ordinary; inner and outer plates of maxilliped ordinary; coxae

2–4 with very weak anterodorsal humps; article 5 of gnathopods free (not cryptic); article 2 of pereopod 7 with small posterior teeth, lacking facial setae; gills present on pereonites 2–7.

Type-species: *Phoxus villosus* Haswell, 1879 (original designation).

Remarks on type-species: Stebbing (1899) designated *Phoxus villosus* as type of his *Parharpinia* but confounded the generic establishment because he did not have *Phoxus villosus* in hand. He probably had *Protophoxus australis* K. H. Barnard in hand as evidenced by his statement that he had a specimen of *Phoxus batei* Haswell as identified by G. M. Thomson, an entity confirmed by Hurley (1954) to be *Protophoxus australis*. The diagnosis was not affected by this confusion because the diagnosis was so brief that it did not touch upon differences between *Protophoxus* and *Parharpinia*.

Composition: The type-species and one new species to be described by Barnard and Drummond (in prep.) from Australia.

Relationship: *Parharpinia* differs from *Paraphoxus* Sars in the presence of dorsal-lateral spines on the telson; in *Paraphoxus* any telsonic spines are always fully apical. *Parharpinia* also bears a special, enlarged medial spine on the peduncle of uropod 1 and has posteriorly setose epimera 1–2. The apical nail on palp article 4 of the maxilliped is more strongly immersed than in species of *Birubius*. *Protophoxus* K. H. Barnard resembles *Paraphoxus* in the absence of posterior setae on epimera 1–2 but the special spine on the peduncle of uropod 1 is fully lateral instead of being fully medial as in *Parharpinia*. Both *Protophoxus* and *Parharpinia* have article 3 of pereopod 5 tapering distally. The telsonic spination in *Protophoxus* is more consistently dorsal than in *Parharpinia*, the latter having a highly variable placement of dorsal and lateral elements often so flexible as to be termed setae; this variability is infraspecific. *Protophoxus* resembles *Paraphoxus* in the absence of long ventral setae on article 2 of pereopod 7 but *Parharpinia* has those setae fully developed.

Parharpinia differs from *Birubius* in the dorsal telsonic setospination, in the presence of the special spine on uropod 1, in the presence of posterior setation on epimera 1–2, and in the taper of article 2 on pereopod 5.

Protophoxus K. H. Barnard

Protophoxus K. H. Barnard, 1930: 335.

Diagnosis of male: Eyes present; flagella of antennae 1–2 unreduced (in male), article 1 of antenna 1 bearing medial fuzz, article 2 short, setae widely spread on ventral surface, primary flagellum with calceoli; antenna 2 lacking ensiform process, article 3 with only 2 facial setules, article 5 not shortened, bearing dorsal calceoli, flagellum with calceoli; upper lip and epistome not strongly distinct from each other; right mandibular incisor with 3 teeth, molar not triturative, small, forming pillow-shaped boss, bearing small articulate spines and fuzz, right lacinia mobilis

bifid, branches unequal, bearing facial denticles, palpar hump of mandible of medium size; lower lip bearing cones; palp of maxilla 1 biarticulate, inner plate with 4 setae; inner plates of maxilliped ordinary, palp article 3 unprotuberant, dactyl elongate, apical nail of medium size, distinct, not deeply immersed; gnathopods small, almost identical in shape but article 5 of gnathopod 2 slightly shortened, hand ordinary ovatorectangular, poorly setose anteriorly, palms oblique; article 5 of pereopods 3–4 bearing posteroproximal setae, article 6 bearing normal 2 rows of spines, middistal armament composed of medium spine, dactyls bearing one inner tooth; article 2 of pereopod 5 of broad form but tapering distally, of pereopod 7 of ordinary phoxocephalid kind, article 3 of pereopod 7 small (ordinary), articles 4–5 of pereopods 5–6 narrow, pereopod 7 of normal large size, article 2 ventrally naked (lacking long setae); peduncular apices of uropods 1–2 naked and weakly combed respectively, peduncle of uropod 1 normally elongate, lacking ventral spike but bearing special large apico*lateral* spine, medial spines widely spread, dorsal spines widely spread, inner ramus of uropod 1 bearing only 1 row of spines, peduncle of uropod 2 with only 1 medial spine set apically, inner ramus spinose, as long as outer ramus, uropod 3 especially elongate, article 2 of outer ramus with only 2 apical setae; telson naked laterally, bearing dorsal spines, midlateral setules normal, placed at about mark 33, comprised of a pair on each side; urosomite 1 devoid of major lateral spines and ventral setae; epimera 1–2 lacking posterior setae, with facial setae located ventrally, none in midface, epimeron 3 lacking posterior setae, with midfacial setae or spines.

Description: Rostrum large and ordinary; facial spines on article 4 of antenna 2 primarily in 1 row scarcely divided into sections, article 5 thick; article 1 of mandibular palp short, apex of article 3 obliquely truncate, palp thin; outer plate of maxilla 1 with 11 spines, 1 spine especially thickened; setation of maxilla 2 ordinary; inner and outer plates of maxilliped ordinary; coxae 2–4 lacking anterodorsal humps; article 5 of gnathopods free (not cryptic); article 2 of pereopod 7 with small posterior teeth, lacking facial setae; gills present on pereonites 2–7.

Type-species: *Protophoxus australis* K. H. Barnard, 1930 (monotypy).

Relationship: This genus is now known to resemble *Parharpinia* Stebbing and to be distinguished from *Paraphoxus* Sars and *Birubius* in the following characters: (1) presence of dorsal spination on the telson; (2) presence of a special spine on the peduncle of uropod 1 and (3) strong taper on article 2 of pereopod 5. *Protophoxus*, however, differs from *Parharpinia* in: (1) the shift of the special spine on uropod 1 onto the full lateral side of the peduncle, whereas in *Parharpinia* that spine is fully medial; (2) the absence of posterior setation on epimera 1–3; (3) the absence of strong ventral setation on article 2 of pereopod 7.

Protophoxus and *Parharpinia* also have thin articles 4–5 on pereopods 5–6 but this character is almost evenly intergraded with some of the thin-membered species of *Birubius*.

Protophoxus australis K. H. Barnard
Figure 4 (part)

Phoxus batei.—Thomson, 1882: 232–233, pl. 17, fig. 2 (not Haswell).
Protophoxus australis K. H. Barnard, 1930: 335–336, fig. 12.
Pontharpinia australis.—Hurley, 1954: 581–587, figs. 1–28.

Material: Terra Nova 135, British Museum (Natural History) No. 1930.8.1:133–137, 8 specimens, 7 in alcohol, 1 mounted on 3 slides; 2 of these are juveniles or very young males as stated by K. H. Barnard, the other 6 are males, none is a female as stated by K. H. Barnard; 1 of the specimens in alcohol resembles female in some respects but detached head is male-like and carcass bears penial processes.

Remarks: The depiction of this species by Hurley (1954) is excellent; all of the details of the generic diagnosis and description given above have been checked and confirmed on the material in hand. Hurley pointed out that his specimen from Cook Strait had only 1 dorsal spine on each lobe of the telson whereas K. H. Barnard showed 5. K. H. Barnard, however, noted specimens from Terra Nova 106 that lacked these spines. We have not seen these but would suspect their identity on that basis. The smallest specimens, 3.5–4.0 mm, in the sample on hand, have 2 spines on each lobe; the largest whole specimen, about 6.5 mm, has 3 on each lobe; K. H. Barnard shows the apical telsonic spination to be composed of 2 short spines separated by a setule; the specimen in hand mounted on slides bears 3 spines on each lobe, 2 outer spines separated by the setule from the inner third spine. We estimate such variables to be normal from our study of Australian phoxocephalids. Hurley's specimen may, however, represent a Cook Strait race of the species.

We append figures of the right lacinia mobilis and uropod 1 from the slide-mounted specimen (size unknown, carcass missing). Inner plate of maxilla 1 of medium size, bearing long middle subapical pluseta, 1 shorter medioapical pluseta and 2 even smaller, almost naked, weakly lateral setae.

Trichophoxus K. H. Barnard

Trichophoxus K. H. Barnard, 1930: 336.

Diagnosis of male: Eyes present; flagella of antennae 1–2 unreduced (in male), article 1 of peduncle on antenna 1 lacking medial male fuzz, article 2 elongate, setae spread widely on ventral surface, primary flagellum with calceoli; antenna 2 with weak ensiform process, article 3 with numerous facial setae, upwards of 15, article 5 shortened, bearing dorsal calceoli, flagellum with calceoli; upper lip and epistome strongly distinct; right mandibular incisor with 4 teeth, molar not triturative, long, massive, conical, bearing 4 enlarged but strongly fixed spines, right lacinia mobilis bifid, rami subequal, bearing facial denticles, palpar hump of mandible small; lower lip lacking cones; palp of maxilla 1 biarticulate,

inner plate with 4 setae; inner plates of maxilliped ordinary, palp article 3 unprotuberant, dactyl elongate, apical nail short and fully immersed or fused; gnathopods small, gnathopod 2 slightly smaller than gnathopod 1, almost identical in shape, wrists elongate, hands thin, mitelloid, heavily setose anteriorly, palms transverse; article 5 of pereopods 3–4 lacking posteroproximal setae, article 6 bearing normal 2 rows of spines, mid-distal armament comprising huge spine, dactyls bearing 1 inner tooth; article 2 of pereopod 5 of broad form, nontapering, of pereopod 7 extended-nasiform, article 3 of pereopod 7 greatly enlarged, articles 4–5 of pereopods 5–6 very broad, pereopod 7 miniaturized; article 2 ventrally setose; peduncular apices of uropods 1–2 weakly combed, peduncle of uropod 1 normally elongate, bearing weak ventral spike, medial spine(s) confined to apical end, dorsal spines fully spread, inner ramus of uropod 1 bearing only 1 row of spines, peduncle of uropod 2 with more than 1 medial spine, inner ramus naked but as long as outer ramus, uropod 3 especially elongate and article 2 of outer ramus probably with 3 apical setae; telson with lateral spines, lateral setules reduced to 1 on each side and shifted highly distad; urosomite 1 with 2 rows of lateral spines, 1 ventral crescent of setae; epimera 1–2 with both posterior and midfacial setae.

Description: Rostrum very small; facial spines on article 4 of antenna 2 in 2 or more main rows, article 5 thin; article 1 of mandibular palp short, apex of article 3 obliquely truncate, palp of medium thickness; outer plate of maxilla 1 with 11 spines, 1 spine especially thickened; setation of maxilla 2 ordinary; inner and outer plates of maxilliped ordinary; coxae 2 and 4 with anterodorsal humps; article 5 of gnathopods free (not cryptic); article 2 of pereopod 7 with small posterior teeth, bearing facial setae; gills present only on pereonites 2–6.

Type-species: *Trichophoxus capillatus* K. H. Barnard, 1930 (monotypy).

Relationship: This genus is now known to be distinguished by numerous characters separating it from *Paraphoxus* Sars to which it was relegated by J. L. Barnard (1960). We have compared it with 38 species of *Birubius*, the basic genus from Australia, and 20 other species of various genera from the northern Pacific Ocean. *Trichophoxus* has its closest relationships to a new genus (genus of 5 species, Barnard and Drummond, in prep.) from Australia. These 2 genera are characterized by the following attributes: (1) the semitriturative molar, enlarged, bearing 4 enlarged poorly articulate spines similar to teeth; (2) the miniaturized pereopod 7 with enlarged article 3; (3) the weakly ensiform process on antenna 2; (4) manifold setation of article 3 on antenna 2; (5) naked posteroproximal margin on article 5 of pereopods 3–4; (6) absence of medial fuzz in males on article 1 of antenna 1; (7) strong distinction between upper lip and epistome; (8) absence of cones on lower lip; (9) poorly developed apical nail on palp article 4 of maxilliped; (10) anterodorsal humps on coxae 2–4; (11) ventral spike on peduncle of uropod 1; (12) presence of 3 (not 2) apical setae on article

2 of outer ramus on uropod 3; and (13) patchwork (in contrast to single row) of denticles on each lobe of male telson.

Trichophoxus is distinguished from the new Australian genus comprising 5 species in numerous characters to be discussed by Barnard and Drummond (in prep.), but a few are given here so as to justify the necessarily long generic diagnosis: (1) lateral spination on urosome; (2) lateral spination on telson; (3) far more numerous setae on article 3 of antenna 2; (4) presence of 4 setae (not 3) on inner plate of maxilla 1; (5) immensity of apical midspine on article 6 of pereopods 3–4; (6) elongation and bareness of inner ramus on uropod 2; (7) normally elongate peduncle of uropod 1; (8) proximal spination on peduncle of uropod 1; (9) presence of only 1 row of spines on inner ramus of uropod 1; (10) presence of only 1 ventral crescent of setae on urosomite 1; (11) strong distal shift of and reduction in number of dorsal setules on telson; (12) absence of any combs on pereopods 5–7; (13) presence of facial humps on right lacinia mobilis; (14) distad shift in primary tooth on dactyls of pereopods 3–4; (15) presence of more than 1 medial spine on peduncle of uropod 2.

In many ways *Trichophoxus* is more primitive than the diverse Australian genus in such characters as peduncles of uropods 1–2 and lack of pereopodal combs but is far more specialized than the Australian genus in telsonic and urosomal ornamentation.

Trichophoxus, our unnamed new Australian genus, and the genus to which *Paraphoxus rakiura* Cooper and Fincham, 1974, should be relegated (new), have numerous affinities as marked by mandibular molar, coxal humps, article 3 of antenna 2, ensiform process of antenna 2, gnathopod form, setation pattern on article 5 of pereopods 3–4, prebuccal parts and the other characters noted above. *Paraphoxus rakiura* should be given a genus of its own, to differ from *Trichophoxus* in the presence of setae on the peduncle of uropod 1, the pattern of the various ornaments on uropods 1–2, and the giant tooth of epimeron 3 among others.

Trichophoxus capillatus K. H. Barnard
Figures 1–3, 4 (in part)

Trichophoxus capillatus K. H. Barnard, 1930: 336–337, fig. 13.

Description of female: Head (broken) about 18+ percent of total body length, greatest width about 110 percent of length, rostrum constricted, narrow, short, exceeding middle of article 1 on antenna 1; eyes

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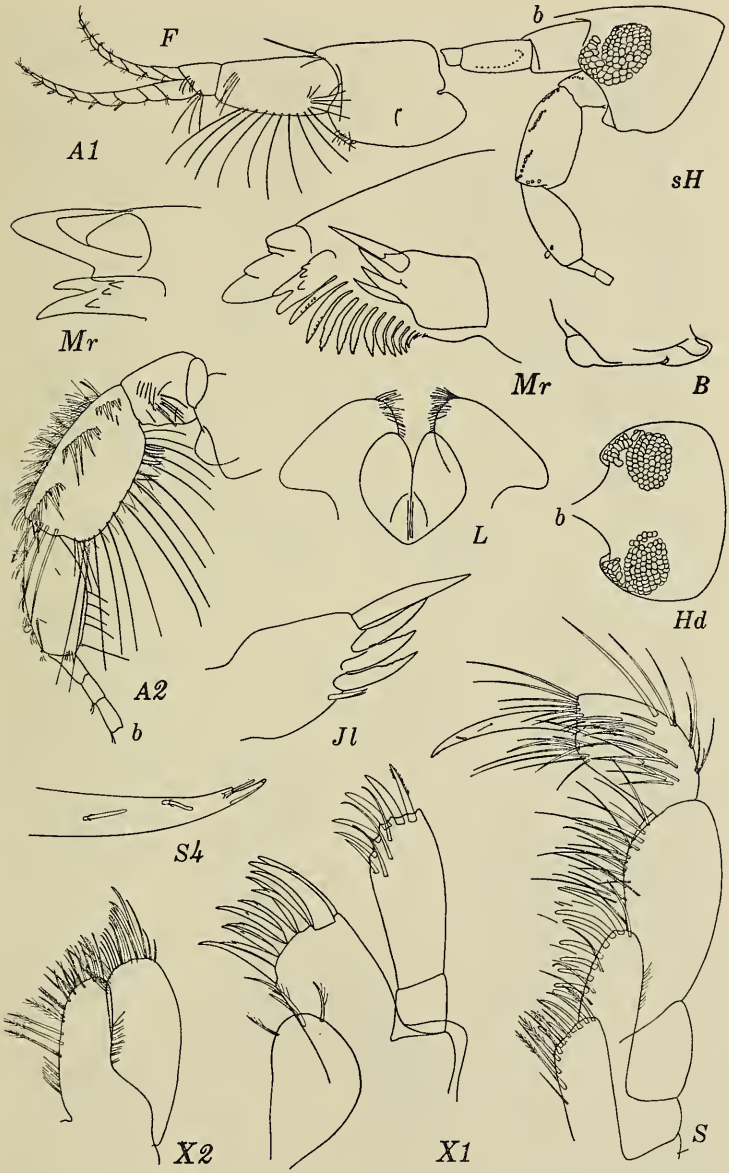
Fig. 1. *Trichophoxus capillatus* K. H. Barnard, lectotype, male, 7.15 mm. A, antenna; B, prebuccal lateral; C, coxa; D, dactyl of pereopod; E, epimeron; F, accessory flagellum; G, gnathopod; H, head; I, inner ramus, J, molar; L, lower lip; M, mandible; O, outer ramus; P, pereopod; Q, cuticle; R, uropod, S, maxilliped; T, telson; U, upper lip; V, pleon;



W, palp; X, maxilla; Y, right lacinia mobilis; a, peduncle; b, broken; d, dorsal; e, enlarged; f, flagellum; i, medial; l, left; n, enlarged; r, right; s, setae removed; z = abnormal.

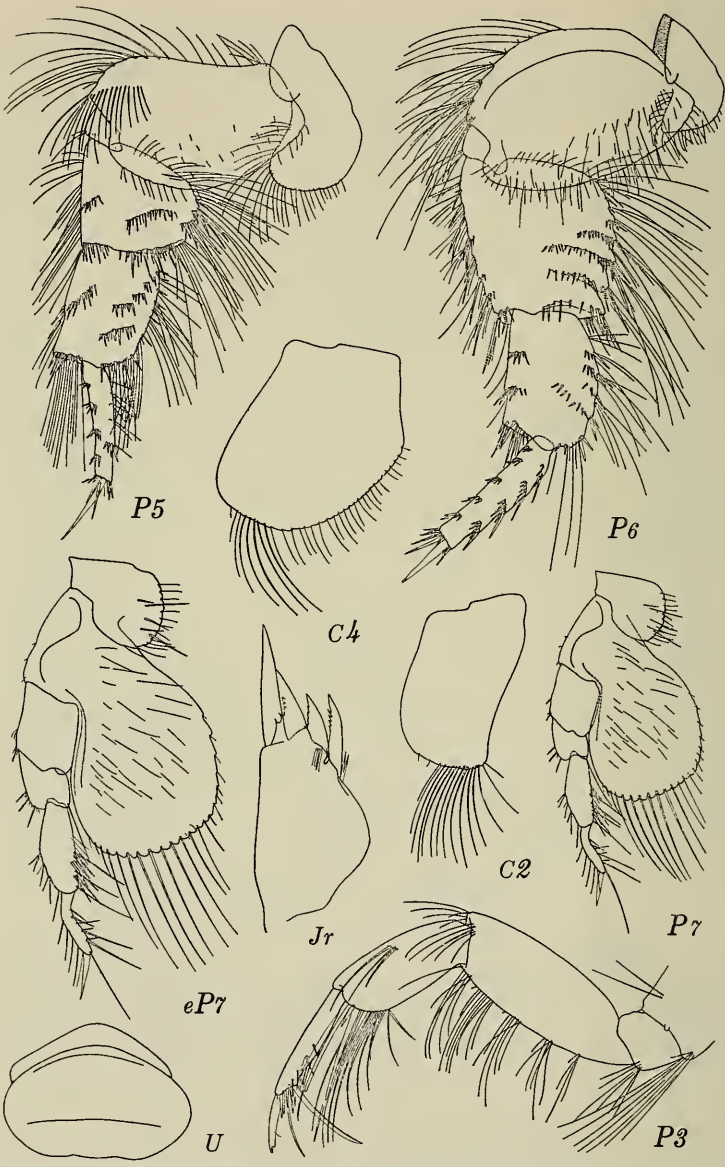


FIG. 2. *Trichophoxus capillatus* K. H. Barnard, lectotype, male, 7.15 mm. Symbols, see Fig. 1.

large, clear of occluding pigment; article 1 of peduncle on antenna 1 about 1.3 times as long as wide, about 1.9 times as wide as article 2, ventral margin with about 20 setules, strongly produced dorsal apex with 3 setules, article 2 about 0.85 times as long as article 1, with ventral crescent of 16 setae, primary flagellum with 9 articles, about 0.7 times as long as peduncle, bearing 1 long aesthetasc on articles 1–8, accessory flagellum with 8 articles; article 3 of antenna 2 with 17 facial setae, spine formula of article 4 = 4-11-11-7 or 4-11-11-6, dorsomedial margin fuzzy, ventral margin with 15 groups of 1–3 long to short setae, 3 ventrodistal setae and 4 dorsodistal spines, article 5 about 0.77 times as long as article 4, facial spine formula = one plus setule, dorsal margin bearing 7 sets of male setae and 1–2 calceoli, ventral margin with 5 sets of short setae, 4 ventrodistal setules, flagellum elongate, with 33 articles, one calceolus each on articles 4, 6, 8, . . . 28 (one side broken); mandibles with weak palpar hump, right incisor with 4 teeth, left incisor with 7 teeth in 2 groups, right lacinia mobilis bifid, distal branch little shorter than proximal, narrow, with 3 facial humps, proximal branch simple, pointed, left lacinia mobilis with 4 teeth, middle teeth weakly shortened, right rakers 12 plus 1 rudimentary, left rakers 11 plus 1 rudimentary, molar composed of elongate soft cones, each molar with 4 large spines, one spine enlarged, each molar with bifid setule, palp article 1 short, article 2 with 6 medium to short inner apical setae and 2 other shorter inner setae and 1 long outer seta, article 3 about as long as article 2, oblique apex with 10 spine-setae, 4 inner setae, basofacial formula = 3 or 2; inner plate of maxilla 1 ordinary, bearing 1 long apical pluseta, and 3 other much shorter setae, palp article 2 with 5 apical spines and 4 submarginal setae; inner plate of maxilla 2 shorter than outer, outer much broader than inner, without apicolateral setae, inner with 7 medial setae; inner plate of maxilliped with 2 large, thick apical spines, 6 apicofacial setae, 4 medial setae, outer plate with 11 medial and apical spines (not all in illustration), 1 apicolateral seta, palp articles 1–2 lacking apicolateral setae, medial margin of article 2 moderately setose, article 3 with 17 facial setae, 8 lateral setae, nail of article 4 fully immersed, with 3 accessory setules; coxa 1 scarcely expanded apically, anterior margin weakly convex, main ventral setae of coxae 1–4 = 11-15-15-32, posteriormost seta of coxae 1–3 shortened, anterior and posterior margins of coxa 4 weakly divergent, posterior margin oblique, convex, posterodorsal corner rounded, posterodorsal margin of ordinary length, almost straight, width-length ratio of coxa 4 = 4:5; long posterior setae on article 2 of pereopods 1–4 = 6-5-5-6, short posteriors = 0-2-0-0, long anteriors = (10–14)-12-3-27, short anteriors = 2-3-4-0, gnathopod 1 also with 4 facial setae; gnathopods with apically narrowed hands, especially on gnathopod 2, width ratios on articles 5–6 of gnathopods 1–2 = 30:26 and 27:25, length ratios = 61:46 and 64:46, palmar humps ordinary to small, respectively, palms transverse, article 5 of gnathopods elongate, ovate, posterior margin rounded-flat; pereopod 4 stouter than pereopod 3 especially on article 4, no margins with combs, facial setae formula on

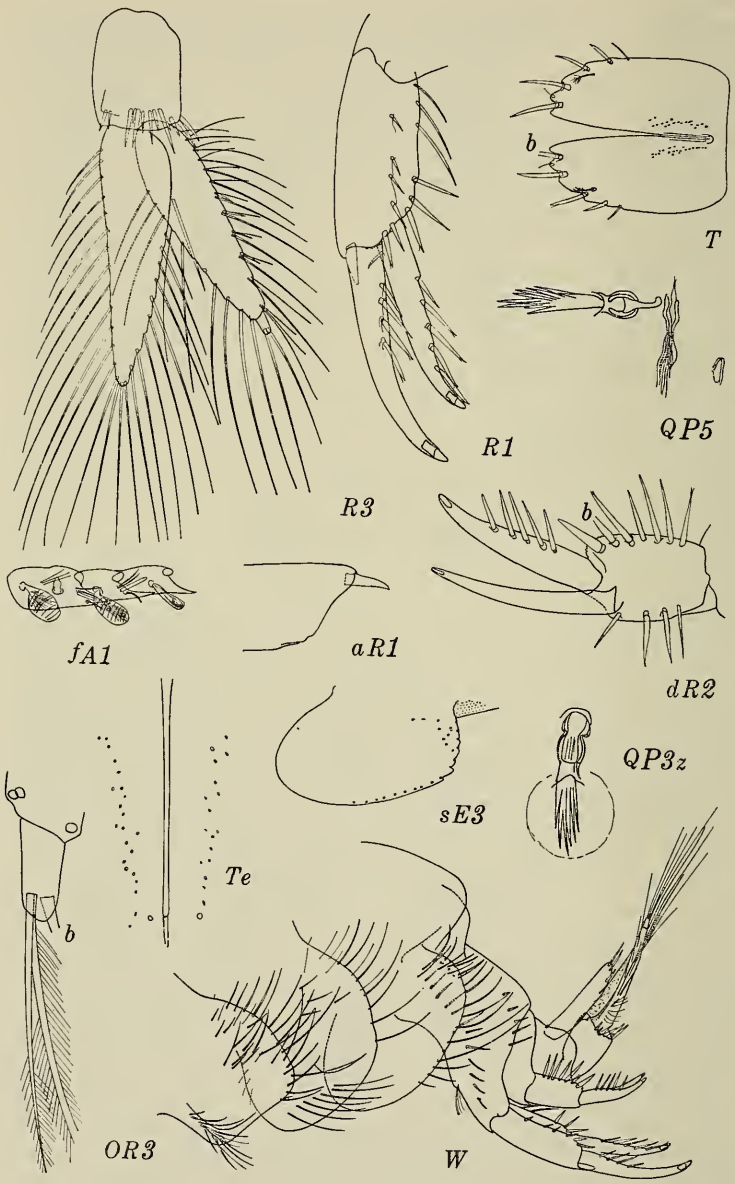


FIG. 3. *Trichophoxus capillatus* K. H. Barnard, lectotype, male, 7.15 mm. Symbols, see Fig. 1.

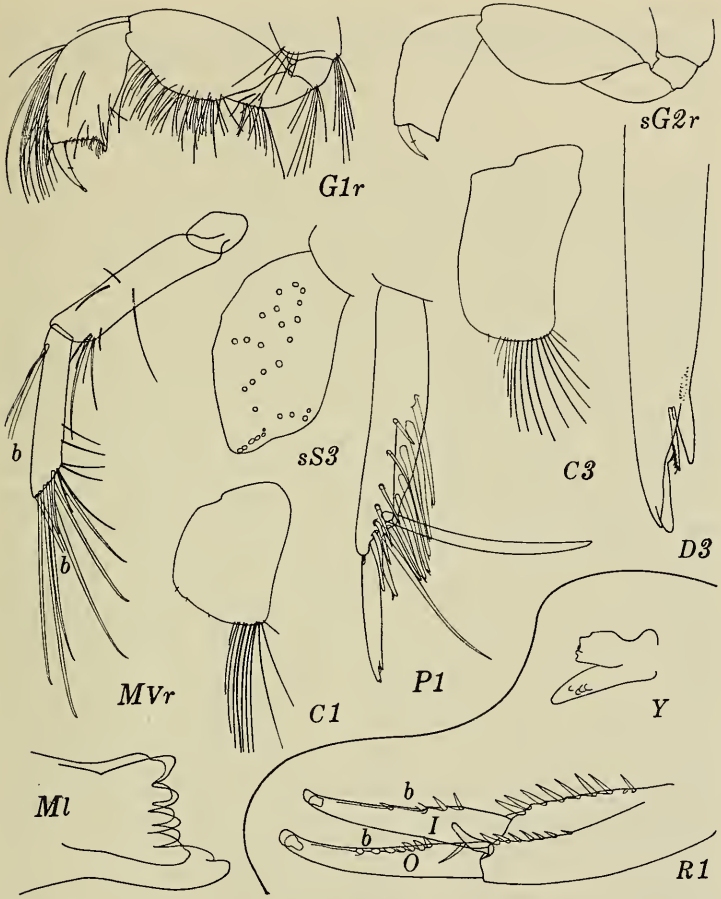


FIG. 4. *Trichophoxus capillatus* K. H. Barnard, lectotype, male 7.15 mm; lower box, *Protophoxus australis* K. H. Barnard, syntype, size unknown. Symbols, see Fig. 1.

article 4 = 5 and 6, on article 5 = 3 and 6, main spine of article 5 extending to M. 85 on article 6, spine formula of article 6 = 7 + 9 and 7 + 8 plus huge middistal spine, acclivity on inner margin of dactyls of pereopods 3–4 highly apicad, sharp, produced as tooth, emergent setule short, midfacial pluseta absent; coxae 6–7 with both facial and marginal setae; articles 4–5 of pereopods 5–6 broad, facial spine rows dense, facial ridge formulas of article 2 on pereopods 5–7 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 5 = 48:44:33:10, of pereopod 6 = 58:

55 : 34 : 13, of pereopod 7 = 53 : 13 : 10 : 3, length ratios of pereopod 5 = 74 : 39 : 45 : 45, of pereopod 6 = 83 : 60 : 51 : 52, of pereopod 7 = 74: 15 : 27 : 19, article 2 of pereopod 7 reaching middle of article 5, with facial and ventral setae, no combs on pereopods 5–7; posteroventral corner of epimeron 1 rounded, posterior margin straight, setose, anteroventral margin with 12 medium setae, face with 16 short to medium setae, posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin weakly convex, setose, ventral facial setae = 7, none set vertically, midfacial setae = 5, posteroventral corner of epimeron 3 rounded, weakly protuberant, with sinus, posterior margin short, weakly convex, serrate, setose, ventral margin with 9 setae, mainly in posterior half, face with several posterodorsal setae; rami of uropods 1–2 with fused apical nails, no ramus with accessory nails, outer ramus of uropod 1 with 4 proximal dorsal spines, apical margin naked, inner with 5 in single row only, outer ramus of uropod 2 with 5 dorsal spines, apical margin naked, inner with none, inner ramus as long as outer, peduncle of uropod 1 with 6 dorsolateral spines, medially with 6 marginal setae and spines, apicalmost an ordinary spine, ventrally with weak spike, peduncle of uropod 2 with 7 dorsal spines, medially with 4 spines, apicolateral corners of peduncles on uropods 1–2 with weak comb, none on rami; peduncle of uropod 3 with 12 ventral spines, dorsally with 1 lateral spinule, 2 medial spines, rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2–3 (3 probably normal), setae, medial and lateral margins setose, article 2 of outer ramus short, 0.10 as long as article 1, bearing 2 long setae, medial margin of article 1 setose, lateral margin with 11–12 acclivities, spine formula = 0×6, 1×3, 0×2, or 0×5, 1, 0, 1, 1, 0, 1, 0, 0, setal formula = 1, 2×10, 3 or 1, 1, 2×7, 3, 2, 3, 3; telson weakly elongate, length-width ratio = 33 : 29, not fully cleft, each apex of medium width, undulate, lateral acclivity deep, with lateral and medial spines separated by setules, each lobe with 3 other lateral spines, midlateral setules shifted distad, one on each side, each lobe with irregular mediobasal denticle patch; urosomite 1 with ventral crescent of 10 setae, 2 lateral facial rows of 12 and 5 spines, articulation line complete, urosomite 1 weakly protuberant dorsally; cuticle with enlarged bulbar setules mixed with pipes, setules surrounded by clear spaces in midst of fine striations in form of linear fingerprint pattern, emergent setules long, branched.

Observations and illustrations: Rostrum broken; eyes slightly disassociated; mandibular molar pointing towards observer but flattened in whole view; all long setae of uropod 3 plumose, article 3 of antenna 2 also with 1 disjunct setule (ordinary phoxocephalid with only 2 facial setules highly disjunct, this species with groups of 17 and 1); telsonic denticles intermediate between linear row and broad patch; right uropod 3 of lectotype with only 2 apical setae, left with additional setule (we presume 3 is normal from our study of related new genera); maxilla 1 with only 11 spines on outer plate, outer spine with facial hump showing as twelfth projection.

Lectotype: British Museum (Natural History) No. 1930.8.1 : 142–144, male, 7.15 mm, from syntypes of K. H. Barnard (1930).

Type-locality: Terra Nova Station 135, New Zealand, North Cape, 1.ix.11, 3 meters, night.

Birubius Barnard and Drummond, new genus

Diagnosis of male and female: Eyes present; flagella of antennae 1–2 unreduced, article 1 of antenna 1 bearing medial fuzz in male, article 2 elongate, setae widely spread ventrally or fully ventral, primary flagellum with calceoli in male; antenna 2 lacking ensiform process, article 3 with only 2 facial setules, apicalmost usually elongate, article 5 not shortened (in standards based on Australian genera), bearing dorsal calceoli in male, flagellum with calceoli in male; upper lip and epistome scarcely distinct, often fully fused but recognizably with upper lip dominant; right mandibular incisor with 3 teeth, molar not triturative, medium to small, pillow-shaped, bearing 4 or more partially articulate spines, usually with fuzz (usually contained on a distinct plusetule), right lacinia mobilis bifid or simple, flabellate or thin, bearing or lacking denticulations and facial humps, palpar hump small to medium; lower lip bearing cones; palp of maxilla 1 biarticulate, inner plate with 4 setae (rarely 3); inner plates of maxilliped ordinary, strongly setose, palp article 3 scarcely or not protuberant, dactyl elongate, apical nail distinct, medium to elongate, not immersed; gnathopods small, similar in shape but article 5 of gnathopod 2 often shorter than on gnathopod 1, never cryptic, hands ovato-rectangular, poorly setose anteriorly, palms oblique; article 5 of pereopods 3–4 bearing setae posteroproximally, article 6 bearing normal 2 rows of spines, middistal spine or seta present, dactyls bearing inner tooth, apical nail weakly distinct or partly fused to body of dactyl; article 2 of pereopod 5 of broad form, untapering, of pereopod 7 of ordinary phoxocephalid kind, article 3 small (ordinary), articles 4–5 of pereopods 5–6 broad to narrow, pereopod 7 of normal size, article 2 ventrally naked or setose; peduncular apices of uropods 1–2 not combed, peduncle of uropod 1 normally elongate, lacking ventral spike or special spines, medial spines widely spread, dorsal spines confined apically, inner ramus of uropod 1 bearing only 1 row of spines, peduncle of uropod 2 with spines either widely spread or confined apically, inner ramus free and elongate; uropod 3 ordinary, article 2 of outer ramus with only 2 apical setae; telson naked laterally and dorsally except for normal pair of setules set about mark 33–45; urosomite 1 usually naked laterally (but occasionally with lateral setae); epimera 1–2 lacking posterior setae, with facial setae located ventrally, none in midface, epimeron 3 ordinary, various, often with facial, posterior and ventral setae, and teeth.

Description: Rostrum various, from ordinary to severely reduced and often narrowed from dorsal view; facial spines on article 4 of antenna 2 in 2 or more rows, article 5 broad; article 1 of mandibular palp either short or weakly elongate, apex of article 3 oblique, palp thin, distal

branch of right lacinia mobilis either flabellate or thin; outer plate of maxilla 1 with 9–11 spines, no inner seta, one spine especially thickened; setation of maxilla 2 ordinary; inner and outer plates of maxilliped ordinary; coxae 1–4 lacking anterodorsal humps; article 5 of gnathopod 2 free (not cryptic); article 2 of pereopod 7 with small posterior teeth, lacking facial setae; gills present on pereonites 2–7.

Type-species: *Birubius panamunus* Barnard and Drummond, new species.

Composition: The type-species and 37 other species to be described by Barnard and Drummond (in prep.).

Relationship: Externally, *Birubius* is difficult to separate from the *Paraphoxus* group of genera but all species have 4 or more spines on each molar of the mandible whereas the *Paraphoxus* group has only 3 spines characteristically clumped basally and rather elongate. The inner plate of maxilla 1 in *Birubius* bears 4 setae, rarely 3, whereas all members of the *Paraphoxus* group bear only 2 setae on the inner plate. *Birubius* has an elongate article 2 of antenna 1 and normal sized article 5 of antenna 2, whereas the *Paraphoxus* group has a short article 2 of antenna 1 and a reduced size of article 5 on antenna 2 (males and females differing in the overall size but each with the article reduced in comparison to each sex of *Birubius*).

Birubius differs from *Parharpinia* and *Protophoxus* in the absence of a special spine on the peduncle of uropod 1, in the absence of supernumerary dorsal spination and setation on the telson and in the elongate article 2 of antenna 1. New American genera of phoxocephalids will be distinguished from *Birubius* (in prep.)

Birubius panamunus Barnard and Drummond, new species

Diagnosis: *Birubius* with fully broadened rostrum; right lacinia mobilis bifid, apical branch flabellate, apically denticulate, proximal branch simple, pointed; coxa 4 with long ventral setae, anterior and posterior margins parallel; epimeron 3 with large posteroventral tooth, bearing oblique facial row of setae, bearing row of ventral setae, posterior margin naked; uropod 1 with basofacial setae, inner ramus with accessory spine adjacent to apical nail, each lobe of telson with 1 stout apical spine and attendant setule.

Holotype: National Museum of Victoria, female "h", 6.5 mm.

Type-locality: Port Phillip Bay Environmental Study Station 1266, 11 March 1971, Port Phillip Bay, Victoria, Australia, 8 m, fine sand.

Remarks: Only 3 of the 38 species in this genus, to be described by Barnard and Drummond (in prep.), have the combination of long setae on coxa 4 and accessory apical nail on the inner ramus of uropod 1. This species differs from the other 2 species in the parallel margins of coxa 4, the fully broadened rostrum and in the presence of a fully developed oblique row of setae on the lateral face of epimeron 3.

Material: 30 samples from 10 stations in Port Phillip Bay, 139 specimens.

Distribution: Australia, Victoria, Port Phillip Bay, 6–22 m, sand, silty sand, clay.

Etymology: *Birubius*, Latinized, masculine, from an Aboriginal word meaning "Southern Cross"; *panamunus*, Latinized, from an Aboriginal word meaning "ocean".

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